

- 37 -

Claims

1. A method for fabricating a heat transfer fin for a heat exchanger, comprising:
 - providing a fin for use in a heat exchanger with a fin body having first and second sides;
 - selecting a tab pattern for the fin, wherein the tab pattern defines a quantity of and location of heat transfer tabs; and
 - forming the heat transfer tabs defined in the tab pattern by creating openings in the fin by removing material from the fin body while retaining a connecting edge between the fin body and the removed material, whereby a tab body is formed from the removed material extending outward from the fin body;
 - wherein the forming step comprises bending the removed material to a bend angle relative to one of the first and second sides and wherein the tab bodies are substantially planar with a majority of the tab bodies aligned parallel to a predetermined directional line.
2. The method of claim 1, wherein the predetermined directional line is an anticipated simple flow path for a cooling gas across the fin body.
3. The method of claim 1, wherein the predetermined directional line is transverse to an anticipated simple flow path to channel flow across the fin in a predetermined direction.
4. The method of claim 1, wherein a minority of the tabs are vortex generators and are aligned at an angle greater than 5 degrees relative to the simple flow path of the cooling gas.
5. The method of claim 4, wherein the minority of the tabs are positioned proximal to a wake region for the plain fin.

- 38 -

6. The method of claim 1, wherein the tab pattern is selected such that at least a portion of the tabs extending from the first or the second side are arranged to direct flow to areas of low flow for the plain fin.

7. The method of claim 1, wherein the fin body includes a leading edge and the
5 majority of the tabs are aligned substantially perpendicular to the leading edge.

8. The method of claim 1, wherein a minority of the tabs are direction vanes at an angle of less than about 10 degrees from the simple flow path to direct flow of a gas flowing over the minority of the tabs into anticipated wake regions.

9. The method of claim 8, wherein the minority of the tabs are aligned such that
10 the tab bodies of the minority tabs are substantially parallel to a local flow path.

10. The method of claim 1, wherein the tab pattern is selected such that during the tab forming step a first portion of the tabs are bent to extend from the first side and a second portion of the tabs are bent to extend from the second side at the bend angle.

11. The method of claim 10, wherein the bend angle is between about 30 and 90
15 degrees.

12. The method of claim 1, wherein the tabs extend a tab height measured from fin body, the tab height being less than about seventy-five percent of a fin separation distance defining a gap between adjacent ones of the fin in a heat exchanger.

13. The method of claim 12, wherein the tab pattern is selected such that the tab
20 bodies have a combined surface area that is less than about 50 percent of a surface area of the first side of the fin body.

14. The method of claim 13, wherein the combined surface area of the tab bodies is between about 10 and 30 percent of the area of the first side.

15. The method of claim 1, wherein the creating of the openings in the fin comprises applying a punch mechanism to the fin body, the punch mechanism configured according to the tab pattern and adapted to concurrently form the tabs extending from the first and second sides of the fin body.

5 16. The method of claim 1, wherein the tab pattern is selected such that the heat transfer tabs only extend from the first or the second side.

17. The method of claim 1, wherein the tabs extend a tab height measured from the side of the fin body from which the tabs extend, the tab height being less than about a fin separation distance.

10 18. A fin for use with tubes in a finned-tube, air-cooled heat exchanger, comprising:

a metallic fin body with first and second heat transfer surfaces and a leading edge;

15 tube collars formed in the fin body for receiving and contacting the tubes of the heat exchanger; and

20 a plurality of tabs extending at a bend angle from the first and second heat transfer surfaces, wherein each of the tabs comprises a substantially planar body and wherein the tab bodies are positioned at offset angles, the offset angles being less than about 20 degrees as measured from a simple flow path extending across the fin body substantially perpendicular to the leading edge of the fin body.

19. The fin of claim 18, wherein the bend angle is between about 70 and 110 degrees as measured from the first or the second heat transfer surface.

20. The fin of claim 18, wherein about 50 percent of the tabs extend from the first heat transfer surface.

- 4 0 -

21. The fin of claim 18, wherein the tabs have a height as measured from the first or second heat transfer surface that is less than about two thirds of a predetermined fin separation distance for the heat exchanger.
22. The fin of claim 18, wherein the tab bodies are generally square or generally 5 rectangular in shape and include at least a partially curved shoulder at a leading edge.
23. The fin of claim 18, wherein the tabs are positioned on the fin body such that the tabs are less densely distributed in a wake region near the tube collars and distal to the leading edge of the fin body.
24. The fin of claim 18, wherein the tabs are arranged in rows relative to the 10 leading edge, and wherein in each of the rows a first portion of the tabs extend from the first heat transfer surface and a second portion of the tabs extend from the second heat transfer surface.
25. The fin of claim 24, wherein each of the tabs extending from a same one of the heat transfer surfaces in each of the rows is offset an offset distance relative to 15 corresponding ones of the tabs in adjacent ones of the rows.
26. The fin of claim 24, wherein adjacent ones of the rows are offset relative to each other such that the tabs in the adjacent rows are not coplanar.
27. The fin of claim 18, wherein the offset angles are less than about 10 degrees.
28. The fin of claim 27, wherein the offset angles differ for at least some of the 20 tabs and the offset angles are selected to position the tab bodies substantially parallel with a plurality of predetermined local flow paths for a fluid flowing adjacent to the heat transfer surfaces.

- 41 -

29. The fin of claim 28, wherein the tab bodies are positioned at angles of less than about 10 degrees as measured from the local flow paths.

30. The fin of claim 18, further including a delta winglet pair associated with each of the tube collars on the first heat transfer surface of the fin body.

5 31. The fin of claim 30, wherein the delta winglet pairs are positioned proximal to the tube collars.

32. The fin of claim 18, wherein a minority of the tabs are aligned at an angle relative to the majority of the tabs, the minority of tabs being positioned proximal to the tube collars and the angle being selected to direct a gas flowing over the fin body 10 around the tube collar.

33. The fin of claim 18, wherein the tabs are positioned adjacent the tube collars to disrupt heat conduction pathways in the fin body that extend substantially parallel to the leading edge away from the tube collars.

34. The fin of claim 18, wherein the fin body comprises a first body half comprising the first heat transfer surface and a planar mating surface and the fin body further comprises a second body half comprising the second heat transfer surface and a planar mating surface, the mating surfaces of the first and second body halves being adjacent.

35. The fin of claim 18, wherein a subset of the tabs are positioned at offset angles greater than 20 degrees to generate turbulence in air flowing across the fin body.

36. The fin of claim 18, wherein at least a subset of the tabs have a surface roughness greater than the heat transfer surfaces of the fin body to promote a transition to turbulence adjacent the portion of the tabs.

- 42 -

37. The fin of claim 18, wherein at least a portion of the first heat transfer surface or the second heat transfer surface of the fin body has a surface treatment selected to promote turbulence adjacent the surface treated portion.

38. An air-cooled heat exchanger, comprising:

5 a plurality of conduits for passing a hot fluid through the heat exchanger; and
 a plurality of fins contacting the conduits, the fins being spaced apart a fin separation distance and defining an air flow passage between adjacent pairs of the fins;

10 wherein the fins comprise:

10 a metallic fin body with first and second sides and a leading edge; and
 a plurality of tabs extending at a bend angle from the first and second sides, wherein the tabs are arranged with a leading edge proximal to a leading edge of the fin body and within about 5 degrees of local flow paths in the air flow passage.

15 39. The heat exchanger of claim 38, wherein the tabs are arranged in rows relative to the leading edge in which a first portion of the tabs extend from the first heat transfer surface and a second portion of the tabs extend from the second heat transfer surface and wherein adjacent ones of the rows are offset relative to each other.

20 40. The heat exchanger of claim 38, wherein adjacent pairs of the fins are connected and the fins comprise metallic foil, and wherein the fins are attached to the conduit by winding in a helical pattern about the outer surface of the conduit.

41. The heat exchanger of claim 38, wherein the tabs are substantially rectangular in shape and the bend angle is about 90 degrees.

25 42. The heat exchanger of claim 38, wherein the tabs have a tab height as measured from the fin body to an edge distal to the fin body in the range of about 25 to about 75 percent of the fin separation distance.

- 43 -

43. The heat exchanger of claim 42, wherein the tab height is in the range of about 40 to about 67 percent of the fin separation distance.

44. An air-cooled heat exchanger, comprising:

a plurality of conduits for passing a hot fluid through the heat exchanger; and

5 a plurality of fins contacting the conduits, the fins being spaced apart a fin separation distance and defining an air flow passage between adjacent pairs of the fins;

wherein the fins comprise:

a metallic fin body with first and second sides and a leading edge; and

10 a plurality of tabs extending at a bend angle from the first side, wherein the tabs are arranged with a leading edge proximal to a leading edge of the fin body and within about 10 degrees of local flow paths in the air flow passage.

45. The heat exchanger of claim 42, wherein the tabs comprise a body having a shape comprising a square, a rectangle, a trapezoid, a triangle, or a semi-circle.

15 46. The heat exchanger of claim 45, wherein the tab body is non-planar with a larger percentage of the tab body surface area proximal to the fin body.

47. The heat exchanger of claim 46, wherein the tab body has an L-shaped or U-shaped cross section when viewed from the leading edge of the fin body.

48. The heat exchanger of claim 44, wherein at least a portion of the tabs extend 20 across the fin separation distance to abut an adjacent one of the fin bodies, whereby the portion of tabs act as spacers between the fins.

49. The heat exchanger of claim 44, wherein the first side is proximal to a lower portion of the heat exchanger such that the tabs extend substantially parallel to the direction of gravity when the heat exchanger is mounted for use.